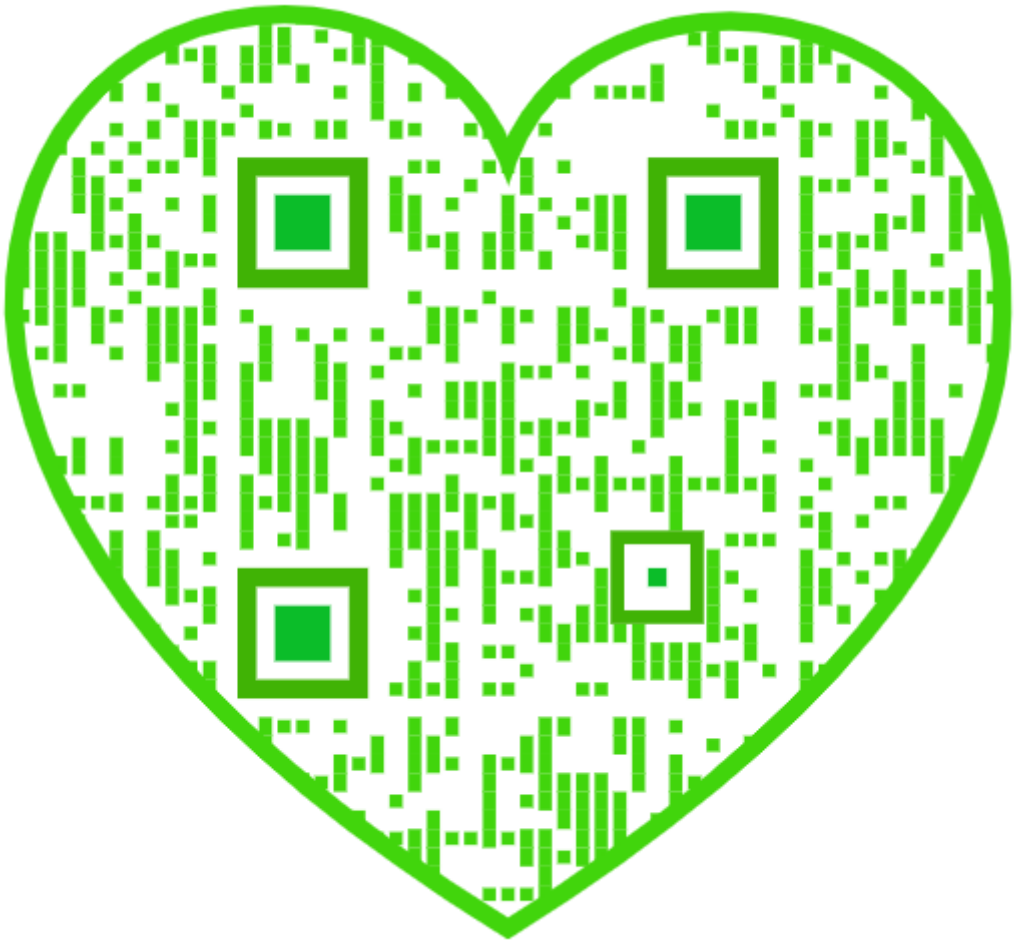

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REPORT ON A HUNDRED CASES

— OF —

ETHER ANÆSTHESIA BY CLOVER'S INHALER.

BY

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REPORT ON A HUNDRED CASES OF ETHER ANÆSTHESIA BY CLOVER'S INHALER.*

By G. Gordon Campbell, B.Sc., M.D.

As the title of my paper suggests, my object is to bring before the Society a report of the results obtainable by the use of Clover's inhaler in ether anæsthesia, rather than a discussion of the subject of anæsthesia in general. There are, no doubt, many members who are not acquainted with this form of inhaler, so I will exhibit the instrument. The following description is copied from Mill's article on Anæsthesia in *Treves' Manual of Surgery*:

"The inhaler consists of a face-piece with an indicator which, by rotation, may be made to point to 0, 1, 2, 3, and F on the circumference of a metallic vessel containing fluid ether; and of a bag into and from which the patient breathes. It is so constructed that when the indicator is at 0 the expired and inspired air passes to and from the bag, without in any way communicating with the ether chamber. If the indicator stands at F, the whole of the expired air must pass through the ether vessel to the bag, and at inspiration return from the bag through the ether vessel. When the indicator is at 2, half the respired air passes to and from the bag direct, the other half passes through the ether vessel, and so on for the other numbers. The air does not pass through the ether but simply through the vessel containing it, and this is sufficient to carry off a large amount of its vapour."

On commencing the administration I pour an ounce and a half of ether into the vessel and rotate the cylinder so that the indicator is at 0. The pillows are then arranged so that the patient's head lies as nearly as possible in a line with the body, that is, as it would be held in standing. The eyes being closed the inhaler is then placed on the face and tilted away from the chin so that the mouth is left free. I then direct the patient to take several deep breaths and lower the face piece in time to catch each expiration, raising it again at inspiration, and thus

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fill the bag with the expired air. The usual result of taking several deep breaths now follows, the succeeding ones are much shallower than normal, and I now turn the cylinder so that the indicator stands at about a quarter way between 0 and 1, which means that the patient is getting about five per cent. of ether vapour in the air breathed.

I think it a good plan not to require the patient to take deep breaths at first, as ether always causes more or less irritation to the respiratory tract, and by beginning with a very small amount the percentage of vapour may often be rapidly increased without producing much distress. If the vapour causes no discomfort the reservoir is now slowly rotated, moving only a short distance at a time and giving a breath of pure air when necessary. At the first sign of intolerance, such as swallowing or raising the hand to remove the inhaler, I give a breath of pure air, and if this fails to quiet the breathing I turn the reservoir back some distance. Very soon a stage is reached at which the patient seems to fall asleep and regular, deep breathing ensues, enabling the ether to be turned on more rapidly, and complete anæsthesia, shown by loss of the corneal reflex and snoring breathing, follows without any further trouble. At the moment full anæsthesia is produced the muscles all over the body relax, the chin falls, and the advantage of having the neck straight is now seen, as where the head is raised too high on the pillows the chin, as it falls, allows the glottis to become closed and the passage of air into the lungs to become more or less completely blocked. If, however, the neck is not bent, placing one finger behind the angle of the jaw and raising it up at once allows of the free passage of air through the larynx. In a few cases of obstruction to the breathing this procedure is unsuccessful and attention should then be turned to the nostrils, which, in many people, under the complete relaxation of deep anæsthesia, collapse at the beginning of each inspiration. Inserting a small piece of stiff rubber tubing of the proper size into each nostril, until the muscles have regained their tone, will remedy this condition. It occasionally happens that instead of relaxation a state of tonic contraction or spasm, affecting the

whole body, follows full anæsthesia. The cause of this rigidity I cannot explain, but by experience I have found that withdrawing the ether altogether, until it passes off, is the best plan of treating it, as on recommencing the administration it is not likely to recur. Pushing the ether seems to prolong the spasm. The condition has occurred eight times in the hundred cases, but in only three of these was it at all marked. Very much less ether is required to keep up than to induce anæsthesia, hence I now turn the indicator back to midway between 1 and 2, and in fifteen minutes or so it can again be moved back, giving less and less ether as time goes on. At the beginning, too, the patient may get one inspiration of air to every three from the bag, gradually increasing the proportion of pure air.

I will now take up in order the various points of which I have kept a record, first,

The length of Time required to produce complete anæsthesia. —The average time for the whole hundred cases is 5.21 minutes, the longest being 11 and the shortest 2½ minutes. This, however, does not fairly represent the time usually necessary, as over 50 per cent. were under five minutes. It must also be noted in considering this average, that the time was calculated from the moment the inhaler was applied to the patient's face until she was ready for operation, as I consider that, from the point of view of both patient and surgeon, the actual time taken up after the inhaler is applied until the patient is ready for operation, is of more practical importance than the number of minutes it takes to induce anæsthesia, when once the breathing of ether vapour has begun. A great many persons will not breathe properly at first, and some time is spent in allowing them to become accustomed to the apparatus before the ether can be turned on to any extent; and I have included this time, although it will be seen that all cases of over six minutes duration were due to this cause and there are twenty of such. Furthermore, it must be remembered that the main point kept in view during the administration is to give the ether with as little discomfort to the patient as possible, and although this lengthens the time somewhat I have not had a single case in

which there was struggling or the patient required any restraint. My rule is, on the patient showing any resistance or crying out, to endeavour to reassure her and at the same time diminish the strength of the vapour. If this fails and struggling and screaming commences, I at once remove the inhaler from the face and, speaking sharply, order her to take the ether quietly, saying I will wait until she does so; and in all but one case this has had the desired effect, perhaps by the substitution of one emotion for another, the fear, or whatever caused the excitement, being replaced by a feeling of resentment at my want of sympathy. The failure referred to is worth alluding to. The patient, after a few breaths, began to scream, and on my removing the inhaler was so excited she could not be induced to commence again for a full hour. The idea had become firmly fixed in her mind that she had entered on what she called the "terrors of death," and that I had recognised her danger in time to remove the inhaler and save her life. Finally, however, she went under in four minutes without a cry, although she was trembling with excitement. Where a second operation has to be performed, the advantage of using no force in the first administration, and of having the patient look back on it with as little dread as possible, is very great.

Percentage of Ether Necessary to Produce Anæsthesia.—In fifty of the cases reported I have kept a record of the proportion of ether vapour, as registered by the indicator, in the respired air, at the moment of full anæsthesia, on the supposition that the air passing through the ether vessel becomes completely saturated with vapour. Estimating the proportion from this basis, I find that the average is 60 per cent.; that is, that the patient becomes fully anæsthetised before the air breathed contains two-thirds of its bulk of ether vapour. The old idea, then, that ether vapour needs to be given as nearly pure as possible must be abandoned.

Amount of Ether Consumed.—The next point I have worked out is the amount of ether consumed during an administration, and this I have obtained by noting the amount of ether used and the length of the administration in 73

cases, of which the shortest was 20 minutes and the longest was 3½ hours. The average length of administration is 91 minutes, or 1½ hours; and the average amount of ether used, four ounces and six drachms by measure (f℥iv f3vi), that is considerably less than a quarter pound tin. The ether in a 100 gramme tin, which measures just five fluid ounces, will suffice for an administration lasting an hour and thirty minutes. About four fluid ounces are required the first hour, and two the next, and so on. There is too, roughly speaking, a relation between the body weight and the amount of ether used, but this is often disturbed by other causes which I am unable to define, but perhaps individual idiosyncrasy is a prominent one.

Vomiting during the Operation.—Vomiting on the operation table occurred four times in the 100 cases: once owing to the ether being withdrawn too soon, and once in an extremely nervous subject. The other two instances were in the same patient on two separate occasions, and were attributed to a large dose of whiskey and water taken just before beginning the ether.

After Vomiting.—I have kept a record of the vomiting occurring while the patient was recovering from the anæsthetic in the last forty cases. Fifteen of these, or over one-third, 37 p.c. were not sick at all, seven were very sick and the others vomited from one to four times. Absence of vomiting does not necessarily mean absence of nausea, but as in most cases nausea is accompained by vomiting, we can get some idea of the relative frequency of after sickness from these figures. The amount of vomiting occurring after the patient comes out of the anæsthetic is also of practical importance in many laparotomies where tension on the abdominal walls from within is desired to be avoided as far as possible.

During the induction of anæsthesia the pulse as a rule becomes very rapid, running up to 120 or 140; at the end of ten minutes, however, it will be found to have quieted down considerably, and it finally falls to between 80–100, and is generally much fuller and stronger at the end of the administration than just before the commencement. On discontinuing the ether, however, the rate rapidly increases again.

The respirations are full and strong and average 25 to 35 to the minute. Quicker respirations mean that more ether is being given than necessary, and slower, that the anæsthesia is on the point of passing off. The rate, therefore, of the breathing, can be used as an indication of the degree of anæsthesia present.

The pupils at the outset dilate, but soon contract, and remain moderately contracted throughout. The presence of the light reflex is seen where the anæsthesia is not very profound; and contraction may thus be produced in one eye from repeated exposure when the other pupil is moderately large.

Sighing is often very marked, it occurs every 45–65 respirations, and seems to have very little significance.

As stated before, I find that patients breathe much more easily when the head is not raised on a pillow in such a manner as to bend the neck. In persons with short thick necks no pillow at all is to be preferred. Closure of the glottis is at once relieved by making extreme extension of the neck, while at the same time the angles of the jaw are drawn forward away from the neck. I have never had to use tongue forceps.

Stiff mucus collecting in the throat and interfering with respiration is easily removed by a small sponge on an old fashioned sponge holder.

In giving the anæsthetic I consider it is absolutely necessary, in order to get good results, to have a quiet room to begin in. Success, both as regards time and comfort, depends upon not exceeding the tolerance of the patient, and the noise made by the air going to and from the bag is what the anæsthetist depends upon to guide him. Any noise which would prevent one from hearing when there is some obstruction to the breathing, will prevent the proper precautions being taken in time to avoid struggling, etc. Moreover, it is found that patients who pass into unconsciousness without excitement and without a struggle, bear the anæsthetic much better during the operation than when there is a stage of excitement. The behaviour of each individual case to the anæsthetic is noted while the patient is going under, and the after conduct of the case is governed by

the knowledge thus gained. When it is at all possible then, the administration should be begun by the one who is to carry it on.

It is claimed that the effect produced by this form of inhaler is, to a great extent, due to asphyxia induced by reduction in the amount of oxygen and re-breathing of expired air; and, moreover, that the breathing of the respired air has a deleterious effect, owing to the poisonous matters eliminated in it. In order to determine as far as possible what portion of the anæsthetic effect was due to asphyxia, I gave the ether in ten cases in the following manner: one respiration of air; inspiration of air; expiration into the bag; one respiration from and to the bag; that is, in every three breaths two are pure air, and then the air in the bag is replenished each time by an expiration containing the amount of pure air in the nose and respiratory passages at the end of inspiration. The foul air in the bag is thus diluted with a certain amount of good air before it is drawn into the lungs. As two breaths of pure air are taken to every one from the bag, the effect produced by asphyxia under such circumstances must be almost nil, when we remember that the patient is breathing at double the normal rate. Now, comparing these ten cases with ten others having respectively corresponding durations, I found that in the cases where the possible effect due to asphyxia was eliminated, the amount of ether used only increased half a drachm in five ounces. Consequently asphyxia cannot be a factor of any practical importance in the anæsthesia induced and kept up in the manner described, although by allowing the patient to breathe very much less pure air in proportion to that from the bag, than is my practice, it may become of importance.

In conclusion let me sum up briefly the advantages claimed for this form of ether inhaler.

Rapidity in the production of anæsthesia combined with but little discomfort to the patient.

The small amount of ether used and the slight escape of ether vapour into the room.

The extremely slight liability to vomiting while under the influence.

The advantage to the anæsthetist of having the exact state of the breathing constantly evident to him through his sense of hearing, and the prime importance of this now that the respiration is admittted on all sides to be the most trustworthy evidence of the patient's condition, and the first function to show the approach of danger.

It is necessary to state for a proper estimate of the value of the foregoing statistics that the patients were, with three or four exceptions, all adult females, and the most of them in a private hospital where all precautions are taken to ensure success. The operation is done between nine and ten in the morning, and no food, except beef tea allowed for twelve hours before. The absence in this report of such after effects as bronchitis, suppression of urine, etc., which are usually attributed to ether, is because none were observed, although the patient was always under observation for at least ten days.

I have appended to the report a table of the individual cases from which my statistics are compiled.

Number of Cases.	Time going under, in minutes.	Percentage of ether reached at moment of complete anæsthesia.	Total length of time anæsthetised (minutes.)	Amount of ether used (fluid drachms.)	Number of times after-vomiting occurred.	Remarks.
1	4	56	80	32	.....	Profound anæmia, sighing 48-65, quiet.
2	9	100	200	61	.....	Talked and cried out just before going under, but no force necessary; ether very cold.
3	4	70	140	40	.....	Stopped giving ether too soon; patient vomited on table
4	6	75	140	44	.....	Large woman.
5	4½	100	.....	.....	.....	Ether very cold.
6	7	75	35	20	.....	Rigidity of whole body 1 minute after abolition of corneal reflex.
7	6	62	....	....		
8	4½	45	25	20	.....	
9	4½	63	70	28	.....	Aged 76.
10	7	62	80	24	.....	Very weak; required very little ether.
11	10	75	110	40	.....	Rigidity and moving hand after abolition of corneal reflex.
12	10	70	90	36	.....	Kept a finger under mouth-piece going under.
13	6	50	....	....	.....	
14	4	62	....	....	....	Sighing very marked.
15	7	84	135	....	.....	Large woman; 5 p. c. ether last 40 minutes.
16	4	50	....	....	.....	
17	4½	50	....	...	.....	
18	5	50			.....	Hiccough at times, stopped by pushing ether.
19	8	....	....	....	.....	

No. of Cases.	Time going under, in minutes.	Percentage of ether reached at moment of complete anæsthesia.	Total length of time anæsthetised (minutes.)	Amount of ether used (fluid drachms.)	Number of times after-vomiting occurred.	Remarks.
20	11	70	....	....	.....	Increased strength of vapour too rapidly causing spasm.
21	10	....	....	....	.....	Removing stitches.
22	4	....	....	....	.....	
23	5	50	....	....	.....	
24	3	70	145	48	.....	Less than 5 p. c. most of time.
25	8	75	55	32	.....	
26	11	....	200	68	.....	Vomited going under, just before anæsthesia complete; 6 p. c. ether after anæsthesia produced.
27	3	50	....	....	.....	
28	7	....	....	....	.....	
29	5	....	....	....	.....	
30	6½	....	....	....	.....	Vomited on the table.
31	8	....	....	....	.....	
32	5	45	....	....	.....	
33	4	63	....	....	.....	
34	5	56	140	44	.....	
35	4	45	140	24	.....	Very slight; emaciated; breathing stopped by mucus in throat; relieved by turning on side; no ether required at all last hour, except an occasional breath.
36	5	45	50	24	.....	
37	7	50	....	....	.....	
38	3½	62	75	44	.....	Large woman; used more ether than usual.
39	5	50	120	48	.....	
40	4½	45	90	40	.....	Ether given on side; elbow used. Kidney case.
41	11	63	....	....	.....	Mouth-piece not fit the face.
42	4	56	45	24	.....	Reflex from perinæum after corneal absent.
43	5	62	85	50	.....	Vomited six times at intervals while completely anæsthetised; given brandy and water just before administration.
44	6	62	....	....	.....	
45	7½	75	105	48	.....	Inhaler not fit the face—No. 41.
46	8	....	50	32	.....	
47	5	50	60	26	.....	
48	3	....	45	24	.....	
49	4½	50	180	64	.....	
50	4	....	....	....	.....	
51	3	....	45	24	.....	Gave 25 p. c. ether all the time.
52	5	....	75	28	.....	
53	4	....	55	28	.....	Very anæmic.
54	3½	75	40	26	.....	Same as 43; vomited once during administration; spirits and water just before.
55	5	....	20	8	.....	Examination abdomen; umbilical hernia.
56	4½	....	60	32	.....	Same case as 55. operation.
57	5	70	60	36	.....	
58	5	....	....	....	.....	Male. Dental case.
59	4½	50	60	32	.....	
60	4	....	....	....	.....	Same case as 59.
61	5	....	120	44	3	
62	6	....	150	48	3	
63	10	....	120	44	1	Mouth-piece not fit; remedied by turning end for end; pulse very slow, 52.
64	3	50	110	44	0	Gave 2 breaths air to 1 ether all through.
65	5	62	90	36	0	2 air to 1 ether; kept indicator at 1½ = 38 p. c.
66	4½	....	150	32	1	Thick mucus in throat; relieved by pulling out the pillow.
67	5	....	115	40	2	2 air to 1 ether.
68	5	..	45	20	0	
69	2½	....	150	56	0	
70	4½	....	110	44	0	

Number of Cases.	Time going under, in minutes.	Percentage of ether reached at moment of complete anæst'a.	Total length of time anæsthetised (minutes.)	Amount of ether used (fluid drachms.)	Number of times after vomiting occurred.	Remarks.
71	10	...	70	26	0	Going under commenced to scream; removed inhaler and waited until she agreed to breathe quietly.
72	4½	....	120	40	6	2 air to 1 ether; kept at 25 p. c.
73	6	....	85	41	1	Very large woman.
74	5	....	60	30	Many	2 air to 1 ether.
75	4	...	90	36	3	2 air to 1 ether.
76	8	....	90	52	0	Large woman; 2 air to 1 ether; large amount used.
77	4	....	120	48	3	2 air to 1 ether.
78	3½	..	45	24	Many	Very nervous woman; spasm of glottis at beginning.
79	7	....	90	40	5	1 ether to 2 air.
80	5	....	135	48	2	2 air to 1 ether.
81	4	....	120	48	3	
82	4	....	30	16	Many	Vomited on the table. Very nervous.
83	5½	....	50	24	3	Same as 81.
84	3½	....	30	16	3	
85	4	....	45	20	4	
86	3½	....	95	34	0	Some spasm and rigidity.
87	3	....	90	48	Many	Same case as 82: mucus in throat.
88	5	50	100	42	0	2 air to 1 ether.
89	3	....	85	48	2	Considerable mucus during operation.
90	4	....	105	52	Many	During administration, spasm lasting so long the patient almost regained consciousness.
91	4	....	95	58	6	
92	4	....	135	88	2	
93	4	50	135	44	0	Case described; screaming and refusal to go on for an hour.
94	5	....	20	8	0	Opening abscess.
95	4	....	120	44	1	No mucus.
96	3½	45	120	44	1	Some sighing; pulse 82 from 120.
97	3	50	50	24	Many	Urine, 8 oz. 1010.; urea 1½ grains to oz. = 12 grains
98	3½	45	90	36	0	Urine ½ oz.; loaded urates: urea 11 grs. to oz. = 5½ grs.
99	3½	60	80	34	0	Abdominal case; urine ½ oz.; urea 5 grains.
100	5	....	110	44	0	Excision of the breast.
	5·21	60	91	38	3 ½	Per cent. without after vomiting.